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ADSORPTION OF RADIUM-226 BY FUNGI

V. Sanmugasunderam and J.L. Dalton
Mineral Processing Laboratory

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SUMMARY

Various fungi of wood origin were tested for their capability to adsorb radium^{226}. Gloeophyllum trabeum (Lenzites trabea) was able to adsorb 15 mCi/g. Since the adsorption was not long-lasting, equilibrium biosorption isotherms, effect of pH, etc. were not studied. Gloeophyllum trabeum was observed to absorb Ba^{133}.

ADSORPTION DU RADIUM-226 PAR DES ORGANISMES FONGIQUES

par

Y. Sanmugasunderam et J.L. Dalton

RÉSUMÉ

Divers organismes se développant sur du bois ont été testés pour déterminer leur capacité d'absorber du radium^{226}. Le Gloeophyllum trabeum (Lenzites trabea) a été capable d'absorber 15 mCi/g. Puisque l'adsorption n'était de longue durée, les isothermes de biosorption d'équilibre, l'effet du pH, etc. n'ont pas été étudiés. Il a été observé de plus que le Gloeophyllum trabeum absorbe le Ba^{133}.

INTRODUCTION

Process waste water and mine water from uranium mines contain radionuclides. Addition of lime to these waters precipitates most contaminants except radium^{226}, which after precipitation is about two orders of magnitude above the prescribed federal standard of 10 pCi/L (1). Although radium in the effluents may be co-precipitated as barium-radium sulphate sludge by the addition of barium chloride, there is considerable concern about the long-term stability of this sludge.

The use of radium-specific absorbents would appear to be an attractive alternative to co-precipitating the radium as a sludge with barium. Microbial mass has been shown to selectively retain heavy metal ions from aqueous solutions. A chance observation, by a researcher who was developing a method for radium analysis led the authors to believe that microorganisms growing on wood would be an excellent adsorbent for Ra^{226}.

Following this lead, various fungi growing on wood were cultured in uranium mill mine tailings solution containing radium. Of these, the fungus which adsorbed the most amount of radium was chosen and attempts were made to quantify the adsorption of the radium per gram of microbial mass. Although radium was adsorbed by the fungi, the adsorption was not stable enough to be used as a suitable adsorbent on a large scale.

MATERIALS AND METHODS

The organisms used in this study, obtained from the Eastern Forest Products Laboratory, Environment Canada by Dr. K. Jongejan, were:

1. *Gloeophyllum trabeum*
2. *Trametes versicolor*
3. *Chaetonium sp.*
4. *Phanerochaete chrysosporium*
5. *Cephalosporium sp.*
6. *Fusarium oxysporum*
7. *Trichoderma viride*

The organisms were initially grown on agar plates containing wood shavings, malt extract (2%), dextrose (0.1%), peptone (0.1%), agar (2%) and one kind of woodshavings. The different kind of woodshavings used were birch, mahogany, maple, oak, pine, spruce and walnut. The organisms were acclimatized to the particular woodshavings by transfers repeated four times.

A layer of malt-extract agar with the chosen wood shaving was 'poured' on the bottom of a 4-litre beaker, and the organisms were transferred to this agar layer by streaking. After 2 weeks of incubation at 35°C in a Puffer-Hubbard Unitherm incubator cabinet, the beakers were filled with 2 litres of tailings solution containing radium. The experiments were conducted in a factorial design to determine the effect of each kind of woodshavings on the different organisms. Aliquots of 200 mL were withdrawn fortnightly, filtered and assayed by alpha-spectroscopy to determine the amount of radium^{226} in solution.

In alpha-spectroscopy the barium-radium sulphate precipitate is placed on an aluminum disc and the number of counts per 8,000 seconds are used to determine the level of Ra^{226}. Based on this method, the adsorption of Ra^{226} by growing cultures of the organism was attempted as follows. Measured quantities of agar were added on previously weighed aluminum discs until the weight of the amount of agar on a set of discs were within 5 mg of each other. One set consisted of six discs. Five of these discs were inoculated with Lenzites trabea, and incubated at 35°C, the sixth was used as a control. After the organism had been grown for two weeks the discs were immersed in a solution containing a known amount of Ra^{226}. Blank agar discs were also immersed in the Ra^{226} solution. Each disc was immersed in 20 mL of the radium solution contained in petri dishes which were sealed with Sellotape to prevent evaporation of the solution. One disc was removed every week. The disc was vacuum dried and assayed for the level of radium adsorbed by counting the number of disintegrations per period. A count of the number of disintegrations from a similar disc which adsorbed 1 mL of a National Bureau of Standards solution of Ra^{226} was taken. A comparison of the counts from organisms on the disc with those of the disc with standard solution enabled calculations to be made of the amount of radium adsorbed by the organism. After alpha-spectroscopy, the blank disc and the disc with the organisms were dried and weighed to determine the dry weight of the organism.

To determine the behaviour of the organisms under continuous flow conditions, about 100 grams of the organisms were harvested and placed in a burette and radium solution was pumped into and out of the burette at different flow rates to give predetermined residence times.

RESULTS

The different woodshavings had no effect on the adsorption of radium by the different organisms, the amount of radium adsorbed by each organism being independent of the type of woodshavings used. However, the amount of radium adsorption per unit period was not uniform.

The organism that had the maximum adsorption capability was Gloeophyllum trabeum. As the results obtained varied from 1500 nCi/g to 15,000 nCi/g, and in some of the experiments the solution after adsorption had more radium than what was started with, it was suspected initially that the variation in the results could be due to the interferences of Ra^{224}. However, the results obtained from the continuous feed runs clearly indicated that the Ba^{133} tracer was used with the radium solution to verify that the assay of Ra was not the cause of the variation in the results obtained. A curious phenomenon observed was that the Ba^{133} also was adsorbed the the biomass. However, even the Ba^{133} adsorption showed the same variability due to desorption encountered in the case of radium.

CONCLUSIONS

Gloeophyllum trabeum adsorbed radium-226. However, since the adsorption was not long-lasting it is not a satisfactory organism to use for biosorption.

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